

The Oviposition Preference and Larval Food Utilization in *Eurema hecabe* (LINNAEUS) (Pieridae)

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Introduction

Foodplants of phytophagous insects are often restricted to one or few species. Although the ranges of foodplants vary with species, the feeding specificities of butterflies are known as the results of coevolution of plants and butterflies. The plants within the same or closely related taxonomic groups have similar secondary chemical compounds which repel or attract insects. It has been considered that the specialization in foodplants of butterflies primarily depends on the existence of these secondary compounds (EHRlich & RAVEN, 1964; FEENY, 1975; FUTUYMA, 1976). Most butterfly species are oligophagous: the larvae feed on some plant species within a particular family.

When a certain butterfly species utilizes several sorts of plants as larval food, two questions as to food utilization arise. The first question is whether these plants can equally support the larval growth. There are several reports concerning the food suitability to larval development. The different foodplants do not always support equally the larval developments of some butterflies (CHEW, 1975; WIKLUND, 1975). The second is whether the foodplants are selected equally by ovipositing females in the field. WIKLUND (1981) reported that females of *Papilio machaon* laid their eggs on only one plant species, though there were many potential foodplants in the field. In some other butterflies, females deposited eggs on several plant species (WIKLUND, 1977; WIKLUND & ÅHRBERG, 1978). On the other hand, CHEW (1977) showed that in pierid butterflies, females oviposited on nearly all available food plant species in the field and that their oviposition preference tended to be determined by the suitability of plants for larval growth, though the females did not always assess accurately the food suitability.

As stated above, the characteristics of foodplant utilization are various with butterfly species. Thus, it may be interesting to evaluate the nutritional effects of foodplants on larval growth and to investigate the selections for foodplants by ovipositing females in the field.

Eurema hecabe (LINNAEUS) (Lepidoptera, Pieridae) is considered to be good material for this kind of study, because it utilizes several leguminous plants as larval food (FUKUDA *et al.*, 1972; KAWAZOÉ & WAKABAYASHI, 1976) and one can easily observe the ovipositing behaviour of females. This butterfly is one of the commonest butterflies being widely distributed in Japan, except northern part. Overwintered adults appear in April and females lay eggs on larval foodplants. It has 4 or 5 generations a year in

lowland of Kantou district. It occurs in grassland, in gaps of forest and around forest edge.

Materials and Methods

In late August, 1979 and 1982, eggs were collected from the census field. These eggs were found on *Lespedeza bicolor* TURCZ. and *L. juncea* PERS. The larvae hatched from these eggs were divided into three groups in 1979 and two in 1982 to feed them on different foodplants. Each larval group was supplied with one of the following five plant species as food; *L. bicolor*, *L. juncea* and *Albizia julibrissin* DURAZ in 1979 and *L. striata* HOOK. et ARN. and *Indigofera pseudotinctoria* MATSUM. in 1982. The larvae were reared individually in a glass cylinder (10 cm in length, 3 cm in diameter) in the laboratory. The temperature and the photophase were not controlled. During this experiment, the average room temperature was 27.1°C. Larvae were reared from late August to late September, 1979. At intervals of one or two days, the larvae were supplied with fresh leaves which had been weighed beforehand. The opening of each cylinder was covered by polyvinyl membrane to prevent the leaves from desiccating. When food was renewed, residues of leaves and faeces were collected and larvae were weighed. The budget of dry matter was determined by standard gravimetric procedures (WALDBAUER, 1968). The budget was presented by the following equation:

$$C = G + M + F$$

where C is the food consumption, G is the larval growth, M is the expenditure on maintaining life processes, F is the faeces and (G + M) is the food assimilation. Dry weights of uneaten leaves and faeces were determined by drying them to a constant weight in an oven at 70°C. Dry weight of supplied food was calculated by using the wet-dry weight ratios of leaves of three foodplant species. These ratios were obtained by drying control leaves to a constant weight at 70°C. Food consumption was calculated by subtracting the weight of uneaten leaves from that of originally supplied ones. In the calculation of the budget, the exuviae were omitted, because they were of a negligible amount. Efficiencies of food utilization were presented as the following three equations.

Approximate digestibility (A. D.):

$$\text{A. D. (\%)} = (G + M) / C \times 100$$

Gross conversion efficiency (E. C. I.):

$$\text{E. C. I. (\%)} = G / C \times 100$$

Net conversion efficiency (E. C. D.):

$$\text{E. C. D. (\%)} = G / (G + M) \times 100$$

The dry matter budgets, the food utilization efficiencies and the larval developmental period were compared among the larvae fed on different food species. The comparison

was applied to the larval developmental stages from the third to pupation, since the dry matter budget was very little in the first and second larval stages.

From August to September, 1981, oviposited eggs were surveyed and ovipositing behaviour of females was observed in the two grasslands on the campus of the University of Tsukuba. Two study areas are situated between the pine forest and the road, being covered with a variety of grasses; *Miscanthus sinensis* ANDERSS., *Artemisia princeps* PAMPANINI, *Cassia mimosoides* OHASHI, *L. striata*, *L. bicolor*, *L. juncea*, *A. julibrissin* and *I. pseudotinctoria*, and sparsely with woody plants. The first area (Area 1) was 500 m apart from the second area (Area 2). The herbaceous vegetation of the Area 2 was similar to that of the Area 1, but with fewer *L. bicolor* and without *A. julibrissin*. As the grassland is mowed every summer, the herbs are provided with new leaves from August to September.

The eggs laid on foodplants were searched by walking through the Area 1 in late August. In this survey, new compound leaves of *L. bicolor*, new leaflets of *A. julibrissin* and the uppermost part of *L. juncea* were regarded as suitable oviposition sites, because *E. hecabe* deposits eggs on new leaves of these plants. In addition, new leaves are considered to be suitable for first-stage larvae to feed on. When eggs were found on a plant, the number of eggs and suitable oviposition sites were recorded.

The ovipositing behaviour was observed in the two study areas on 24, 31 August and on 2, 3, 9 September, 1981, when the weather condition was good for oviposition. Each female was followed and observed until she went out from the study areas or stopped ovipositing behaviour. The plant species landed on, the number of alightings on the plant and the number of eggs laid on the plant were recorded.

Results

The larvae fed on the leaves of *L. bicolor*, *L. juncea* and *A. julibrissin* normally developed into the pupal stage, but all the larvae on *L. striata* or *I. pseudotinctoria* died during the first-stage without consuming the food leaves. Therefore, the dry matter budgets and the efficiencies of food utilization of larvae on these two plants could not be measured.

Table 1. Larval period from third-stage to pupation, larval weight and pupal weight of *E. hecabe* reared on different foodplants. Mean values \pm standard deviation.

Foodplant	N	Period (days)	Larval max. weight (mg)	Pupal weight (mg)
<i>Lespedeza bicolor</i>	12	12.5 \pm 0.5 ^a	150.6 \pm 12.0 ^a	137.1 \pm 9.3 ^a
<i>Lespedeza juncea</i>	12	13.8 \pm 1.0 ^b	136.2 \pm 11.6 ^b	122.3 \pm 9.7 ^b
<i>Albizia julibrissin</i>	12	13.2 \pm 1.0 ^c	137.7 \pm 10.0 ^b	121.1 \pm 11.1 ^b

Note: Any two means not having a common superscript are significantly different at the 5% level of probability.

The number of reared larvae, duration from third-stage to pupation, maximum larval weight and pupal weight of larvae on three different foods are summarized in Table 1. The larvae on *L. bicolor* grew fastest, but the difference in the duration was only 1.3 day between larvae on *L. bicolor* and those on *L. juncea*. The maximum larval weight and the pupal weight were larger in the larvae on *L. bicolor* than those on the others.

The budgets of dry matters are summarized in Table 2. Food consumptions were not different among larvae on different foodplants. The larvae on *L. juncea* excreted larger amount of faeces than those on the two other foods. The growth of larvae on *L. bicolor* was significantly greater than those on the other foods, but it was not significantly different between the larvae on *L. juncea* and those on *A. julibrissin*.

Table 2. Dry matter budgets(mg) for *E. hecabe* larvae reared on different foodplants. Mean values \pm standard deviation.

Foodplant	Food consumption	Faeces	Food assimilation	Larval growth
<i>Lespedeza bicolor</i>	135.8 \pm 10.6 ^a	93.1 \pm 11.3 ^a	42.6 \pm 5.1 ^a	25.0 \pm 2.2 ^a
<i>Lespedeza juncea</i>	142.2 \pm 11.7 ^a	104.3 \pm 8.6 ^b	37.9 \pm 6.5 ^b	22.6 \pm 2.0 ^b
<i>Albizzia julibrissin</i>	145.6 \pm 18.1 ^a	93.8 \pm 12.0 ^a	51.9 \pm 14.1 ^c	22.8 \pm 1.8 ^b

Note: Any two means not having a common superscript are significantly different at the 5% level of probability.

The efficiencies of food utilization are summarized in Table 3. A. D. value of the larvae on *A. julibrissin* was the highest, but the value was not significantly different with larvae on *L. bicolor*. E. C. I. value was higher in the larvae on *L. bicolor* than in those on the other foods. E. C. D. values varied from 46.6% on *A. julibrissin* to 61.4% on *L. juncea*. The E. C. D. value of larvae on *A. julibrissin* was significantly lower than those on the other two foods ($P < 0.01$).

Table 3. Efficiency of food utilization by *E. hecabe* larvae reared on different foodplants. (Mean values \pm standard deviation)

Food plant	A.D. (%)	E.C.I. (%)	E.C.D. (%)
<i>Lespedeza bicolor</i>	31.5 \pm 4.0 ^a	18.5 \pm 2.2 ^a	59.4 \pm 8.7 ^a
<i>Lespedeza juncea</i>	26.6 \pm 3.5 ^b	15.9 \pm 1.6 ^b	61.4 \pm 12.3 ^a
<i>Albizzia julibrissin</i>	35.3 \pm 7.1 ^a	15.8 \pm 1.2 ^b	46.6 \pm 10.9 ^b

Note: Any two means not having a common superscript are significantly different at the 5% level of probability.

The eggs of *E. hecabe* were found on three leguminous plants; *L. bicolor*, *L. juncea* and *A. julibrissin*. The numbers of plants surveyed, their suitable oviposition sites and

Table 4. Number of plants deposited by *E. hecabe* in relation to number of plants surveyed, number of eggs and number of suitable oviposition sites at the Area 1.

Foodplant	No. plants surveyed	No. plants with oviposited eggs	Ratio of plants with oviposited eggs	No. eggs laid	No. suitable sites for oviposition	Mean no. eggs per suitable sites
<i>Lespedeza bicolor</i>	85	34	40.0%	78	869	0.10
<i>Lespedeza juncea</i>	115	58	50.4%	120	549	0.23
<i>Albizzia julibrissin</i>	19	9	47.4%	20	165	0.08

eggs on the plants are shown in Table 4. The number of plants surveyed also represented the relative abundance of the three plant species in the study areas. *L. juncea* was the most abundant species and *A. julibrissin* was very few compared with the two other species. The mean number of suitable oviposition sites per plant varied from 5.0 in *L. juncea* to 10.5 in *L. bicolor*. Most of *L. juncea* had less than five sites, while many of *L. bicolor* had more than six sites (Fig. 1). *A. julibrissin* was very small with a few leaves in the study area because of grass-cutting. There was no difference among these three plants in the ratio of the plants with oviposited eggs to the total plants surveyed (Table 4). However, the mean number of eggs per suitable oviposition site was significantly higher in *L. juncea* than in the two other plants ($P < 0.01$).

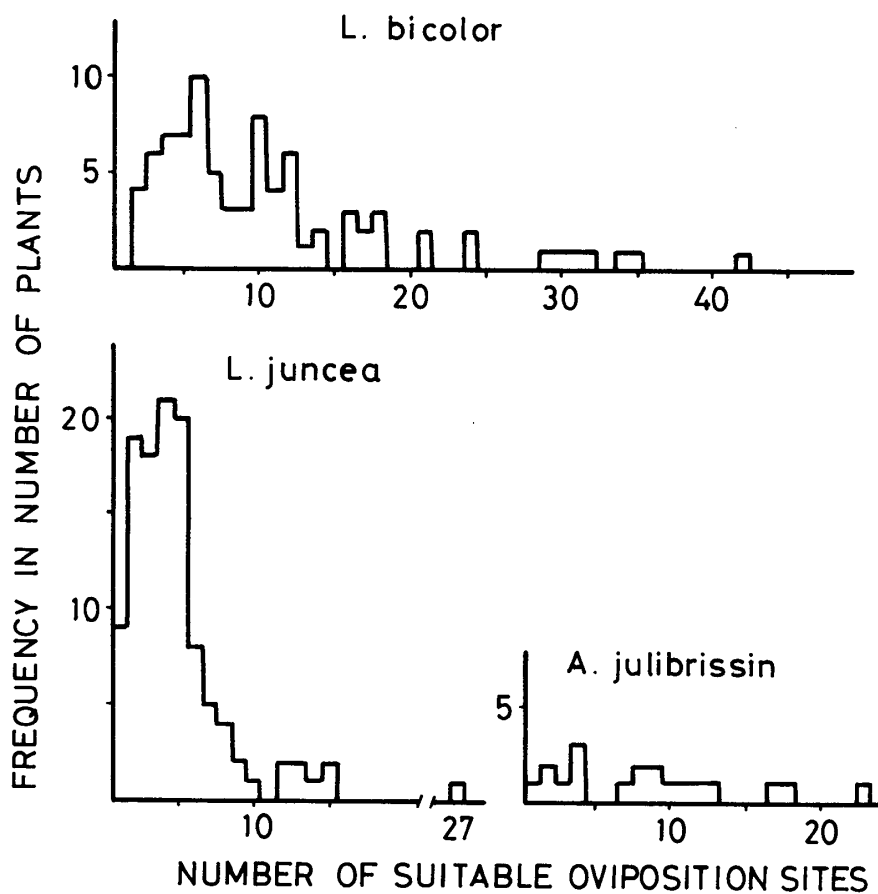


Fig. 1. The number of suitable oviposition sites in three plant species.

The ovipositing behaviour was observed for 28 females in the two study areas. The duration of observation for each female varied from 3 to 15 minutes. Females fluttered close to the vegetation and alighted on several plant species. When the females landed on plants other than their larval food, they immediately flew away. In addition, they did not always oviposit even when they alighted on the larval food-plants. Females stopped ovipositing behaviour when they encountered males or the wind became strong. Although the females alighted on many leguminous plant species, such as *L. juncea*, *L. bicolor*, *L. striata*, *A. julibrissin*, *I. pseudotinctoria*, *Sophora flavescens* SOLAND., *Wistaria floribunda* D. C., they deposited eggs on only three plant species, namely, *L. juncea*, *L. bicolor* and *A. julibrissin* (Fig. 2). The results of observation on ovipositing females in the two areas are shown in Table 5. In the Area 1, females alighted on *L. juncea* more frequently than expectation derived from the relative

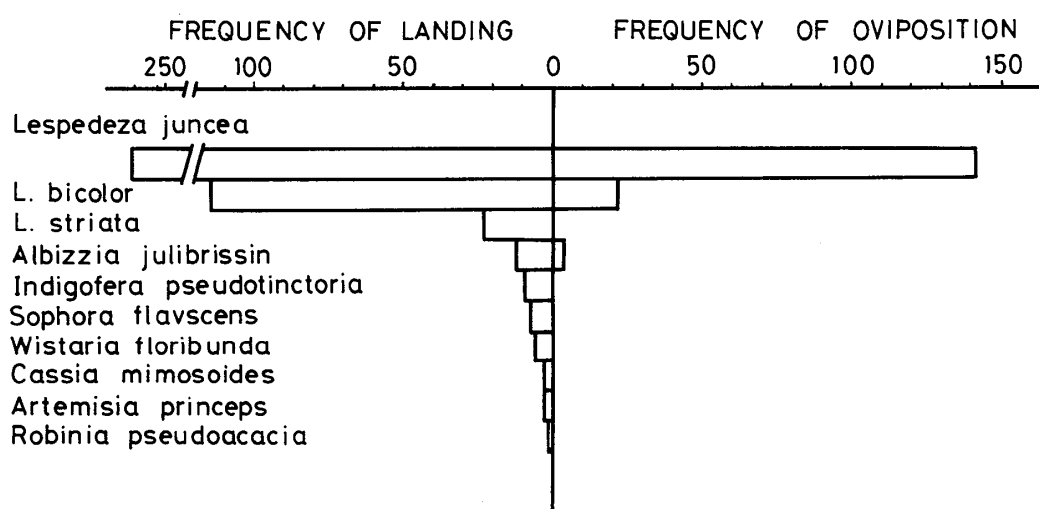


Fig. 2. Frequency of alightings and the number of ovipositions for the plants in the study areas.

Table 5. Number of plants deposited in relation to number of plants alighted by *E. hecabe*, number of eggs laid and number of alightings.

Foodplant	No. plants alighted (A)	No. plants oviposited (B)	Ratio of oviposited plants (B/A × 100)	No. of eggs	No. of alightings
AREA 1					
<i>Lespedeza bicolor</i>	61	21	34.4%	22	104
<i>Lespedeza juncea</i>	140	78	55.7%	85	157
<i>Albizzia julibrissin</i>	11	3	27.3%	4	12
AREA 2					
<i>Lespedeza bicolor</i>	6	0	0.0%	0	11
<i>Lespedeza juncea</i>	93	53	57.0%	57	104

abundance of the foodplants. The ratios of oviposited plants were significantly different from each other among three plant species. Ovipositing females preferentially alighted on and oviposited on *L. juncea* in the Area 1. In the Area 2, most female alighted on *L. juncea* and oviposited only on this plant. Many females passed *L. bicolor* without alighting on the plant in this area. The ratio of plants oviposited to plants alighted by females was similar to that in the Area 1 for *L. juncea*.

The number of landings per plant was larger on *L. bicolor* than on other plants (Table 5). In addition, there was a positive correlation between the number of alightings per plant and the ratio of oviposition on the plants in *L. juncea* and *L. bicolor* (Table 6). In one alighting, about 50% of *L. juncea* were oviposited and about 20% of *L. bicolor* were done by females. When females alighted twice on *L. juncea*, almost all of them oviposited on the plant.

Table 6. Number of plants alighted and oviposition rate* (in parentheses) in relation to number of alightings per plant by *E. hecabe*.

Foodplant	Area	Number of alightings per plant					
		1	2	3	4	5	6
<i>Lespedeza</i>	1	41 (19.5)	7 (42.9)	7 (71.4)	2 (50)	4 (100)	—
<i>bicolor</i>	2	5 (0.0)	—	—	—	—	1 (0.0)
<i>Lespedeza</i>	1	124 (51.6)	15 (93.3)	1 (100)	—	—	—
<i>juncea</i>	2	83 (55.4)	9 (100)	1 (100)	—	—	—

* The percentage of the number of plants oviposited.

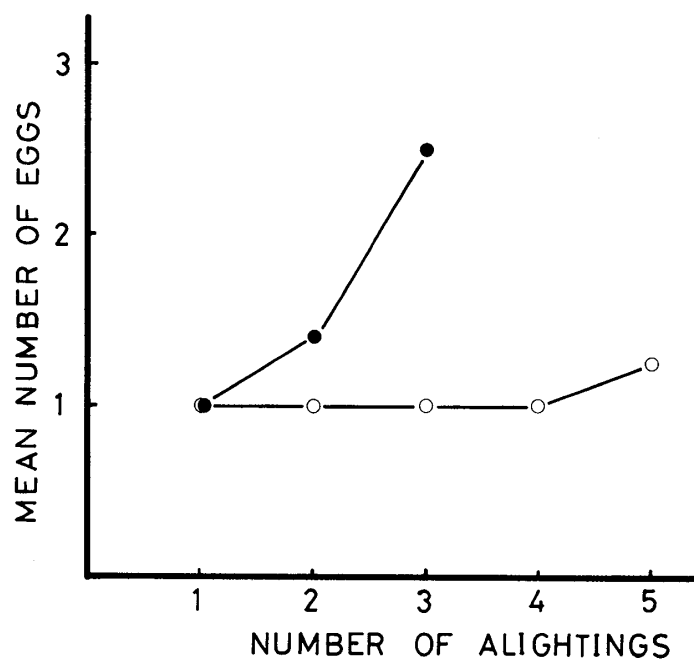


Fig. 3. Relation of the number of eggs deposited to the number of alightings on two plant species.

Open circle: *L. bicolor*. Closed circle: *L. juncea*.

The mean number of eggs on one plant increased in proportion to the number of lightings in *L. juncea*. On the other hand, the number of eggs did not increase in *L. bicolor* in such a manner (Fig. 3).

Discussion

Three plant species used in the rearing experiment are known to be larval food for *E. hecabe* in the field. There were several reports concerning the influences of qualitative differences of various foodplants on the growth of larvae fed on these plants (CHEW, 1975; WIKLUND, 1975). The survival rate of larvae, larval developmental period, larval or pupal weight and food utilization efficiencies were used as indicators of the nutritional adequacy of the foodplant for insects (SOO HOO & FRAENKEL, 1966; BECKWITH, 1970; BAILEY, 1976; TABASHNIK, 1983). The larval survival rates were 100% in the laboratory on the three plants; *L. bicolor*, *L. juncea* and *A. julibrissin*. Contrary to the result, all larvae on *L. striata* and *I. pseudotinctoria* died during the first-stage. These two plants seemed to be unsuitable as food for *E. hecabe*.

In general, plants which enable larvae to grow rapidly are thought to be more suitable food, because the larval stage seems to be vulnerable to predation and parasitism. In addition, CHEW (1975) showed that larvae on foods which supported rapid growth might be more likely to complete larval development before the condition of foodplant became unsuitable. The present study indicated that there was statistical difference in the larval developmental period among the three suitable foodplants (Table 1). However, the differences were only 0.6–1.3 days among the larvae on three foodplants.

Larval weight and pupal weight have also been used as an indicator of food suitability for insects. For example, heavier larvae or pupae of two lepidopterous species are known to produce more eggs when they become adults (BECKWITH, 1970; BAILEY, 1976). Thus, the reproductive capacity of insects is influenced by their larval foods. The maximum larval weight and the pupal weight of *E. hecabe* were significantly larger in the larvae on *L. bicolor* than in those on the other foodplants (Table 1). It may be advantageous for the larvae of *E. hecabe* to feed on *L. bicolor* because of having larger fecundity. However, judging from the differences in the maximum larval or pupal weights, this advantage may be slight.

The difference in the larval growth may be due to the difference in the food utilization efficiency of the larvae. To obtain the optimal larval development, it is necessary for larvae to intake adequate foods and efficiently convert them to their body. To achieve the high gross conversion efficiency (E. C. I.), the values of approximate digestibility (A. D.) and net conversion efficiency (E. C. D.) must be high. The larvae on *L. juncea* had high E. C. D. but low A. D. Contrary to this, A. D. was high for larvae on *A. julibrissin* but their E. C. D. was low. Since larvae on *L. bicolor* had high A. D. and E. C. D., the E. C. I. was the highest of the three groups (Table 3).

These results revealed that *L. bicolor* was slightly superior to the other plants as larval food of *E. hecabe*. However, *L. juncea* and *A. julibrissin* also sufficiently supported the larval growth. Accordingly, it can be concluded that these three plant spe-

cies are nutritionally suitable larval food of the butterfly.

The eggs of *E. hecabe* were found on three plant species; *L. juncea*, *L. bicolor* and *A. julibrissin* in the study areas. No egg was found on other leguminous plants. Furthermore, the field observation clearly indicated that females deposited their eggs only on these three plants, though they alighted occasionally on the other plants. Some butterfly species are known to oviposit on unsuitable plants for the larval development (WIKLUND, 1975, 1981; CHEW, 1977). However, in *E. hecabe*, females did not lay their eggs on unsuitable plants. Thus, only these three plant species were firmly established as the foodplants of *E. hecabe* in this area.

There were many leguminous plants in the study areas, but ovipositing females mainly alighted on *L. juncea* and *L. bicolor*. The ovipositing females seemed to discriminate foodplants while flying by using visual cue. When females alighted on non-foodplants, they tended to choose plants which have stems stood out. Females also had a tendency to alight on the plants having small or slender leaflets. RAUSHER (1978) reported that ovipositing females formed search images for leaf shape and females having this images increased the rate of discovery of host plants. *E. hecabe* probably searched for foodplants in the field by imaging the shape of leaflet and forms of plants, because ovipositing females alighted mainly on *L. juncea* which was slender in form and was provided with slender leaflets.

There was difference between *L. juncea* and *L. bicolor* in the ratio of the number of plants on which eggs were oviposited to that of plants alighted on (Table 5). Most females alighted on *L. juncea* decided by one alighting to oviposit on the plant. Contrary to this, females on *L. bicolor* decided it by more than two alightings in many cases (Table 6). This implied that *L. juncea* made females decide to oviposit on the plant sooner than *L. bicolor*. Judging from the field observation, *E. hecabe* seemed to have preferably oviposited on *L. juncea* in the study areas. However, the preference may not be so firm, because many females were observed to oviposit on *L. bicolor* and *A. julibrissin*, and actually the eggs were found on these two plants.

In spite of the fact that *L. bicolor* is slightly superior to *L. juncea* as larval food, females of *E. hecabe* deposited eggs on *L. juncea* more frequently than *L. bicolor* in the field. TABASHNIK (1983) showed, in *Colias* species, that the ability of food utilization of larvae and the oviposition preference of females are not always changed in gearing.

The oligophagous butterfly species was prone to become monophagous in the case which they used the predictable resource (WIKLUND, 1977). *L. juncea* seemed to be stable resource for *E. hecabe*, because it was very abundant in the study area from spring to autumn except grass-cutting period. However, *E. hecabe* is oligophagous. This may partly be explained as follows: *L. juncea* grows more abundantly than *L. bicolor* in the grassland. Contrary to this, *L. bicolor* and *A. julibrissin* are found in gaps of forest and around forest edge rather than in the grassland. Therefore, by utilizing three different plant species, this butterfly is able to inhabit a variety of habitats which are distributed patchily in this region.

Summary

The nutritional effects of foodplants on larval growth and the oviposition preference of females were studied for *E. hecabe*. The larvae were reared with five different plants. The larvae which fed on *L. bicolor*, *L. juncea* and *A. julibrissin* developed normally, but all larvae on *L. striata* and *I. pseudotinctoria* died during the first-stage. The first three plants are nutritionally subequally suitable as food for the development of the larvae of *E. hecabe*, though *L. bicolor* was slightly superior to *L. juncea* and *A. julibrissin* with respect to developmental velocity and larval or pupal weight gain.

The eggs of *E. hecabe* were found on three plants; *L. bicolor*, *L. juncea* and *A. julibrissin*. Females of *E. hecabe* were observed in the field to deposit only on these three plants, although they alighted on other leguminous plants. The females were observed to oviposit preferably on *L. juncea* in the grassland.

L. juncea and *A. julibrissin* grow in gaps in the forest and around forest edge rather than in the grassland. By utilizing these three plants, *E. hecabe* is considered to be able to inhabit a variety of habitats.

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References

- BAILEY, C. G., 1976. A quantitative study of consumption and utilization of various diets in the bertha armyworm, *Mamestra configurata* (Lepidoptera: Noctuidae). *Can. Ent.*, **108**: 1319–1326.
- BECKWITH, R. C., 1970. Influence of host on larval survival and adult fecundity of *Choristneura conflictata* (Lepidoptera: Tortricidae). *Ibid.*, **102**: 1474–1480.
- CHEW, F. S., 1975. Coevolution of pierid butterflies and their cruciferous foodplants. I. The relative quality of available resources. *Oecologia*, **20**: 117–127.
- , 1977. Coevolution of pierid butterflies and their cruciferous foodplants. II. The distribution of eggs on potential foodplants. *Evolution*, **31**: 568–579.
- EHRlich, P. R. & P. H. RAVEN, 1964. Butterflies and plants: A study in coevolution. *Ibid.*, **18**: 586–608.
- FEENY, P., 1975. Biochemical coevolution between plants and their insect herbivores. In GILBERT, L. E. & P. H. RAVEN (ed.), *Coevolution of animals and plants*. pp. 3–19. Univ. Texas Press, Austin and London.
- FUKUDA, H., K. KUBO, T. KUZUYA, A. TAKAHASHI, M. TAKAHASHI, B. TANAKA & M. WAKABAYASHI, 1972. *Insects' life in Japan*. Vol 3: Butterflies. xvi+278 pp., 56 pls. Hoikusha, Osaka.
- FUTUYMA, D. J., 1976. Foodplant specialization and environmental predictability in Lepidoptera. *Am. Nat.*, **110**: 285–292.
- KAWAZOÉ, A. & M. WAKABAYASHI, 1976. Coloured illustrations of the butterflies of Japan. vii+422 pp., 72 pls. Hoikusha, Osaka.
- RAUSHER, M. D., 1978. Search image for leaf shape in a butterfly. *Science*, **200**: 1071–1073.

- SOO, HOO, C. F. & G. FRAENKEL, 1966. The consumption, digestion, and utilization of food plants by a polyphagous insect, *Prodenia eridania* (CRAMER). *J. Insect Physiol.*, **12**: 711-730.
- TABASHNIK, B. E., 1983. Host range evolution: the shift from native legume hosts to alfalfa by the butterfly, *Colias philodice eriphyle*. *Evolution*, **37**: 150-162.
- WALDBAUER, G. P., 1968. The consumption and utilization of food by insects. *Adv. Insect Physiol.*, **5**: 229-288.
- WIKLUND, C., 1975. The evolutionary relationship between adult oviposition preferences and larval host plant range in *Papilio machaon*. *Oecologia*, **18**: 185-197.
- 1977. Oviposition, feeding and spatial separation of breeding and foraging habitats in a population of *Leptidea sinapis* (Lepidoptera). *Oikos*, **28**: 56-68.
- 1981. Generalist vs. specialist oviposition behaviour in *Papilio machaon* (Lepidoptera) and functional aspects on the hierarchy of oviposition preferences. *Ibid.*, **36**: 163-170.
- & C. ÅHRBERG, 1978. Host plants, nectar source plants, and habitat selection of males and females of *Anthocharis cardamines* (Lepidoptera). *Ibid.*, **31**: 169-183.

摘 要

キチョウにおける産卵植物と幼虫の餌利用 (伴野英雄)

キチョウにおける食餌植物の餌としての価値について、幼虫の飼育実験から検討した。また、産卵植物の選好性について、野外における産卵植物の調査と♀の産卵行動の観察から調べた。

飼育実験では、幼虫の成長日数、物質収支、餌の利用効率について調べた。食餌植物として、メドハギ、ヤマハギ、ネムおよび野外観察において産卵中のメスがよく止ることが観察された。ヤハズソウ、コマツナギの5種のマメ科植物を用いた。ヤハズソウ、コマツナギを与えた場合、幼虫はごく僅かしか摂食せず、すべて1齢で死亡した。他の3種を与えた幼虫はすべて順調に生育した。このうち、ヤマハギを与えた幼虫では、他の2種を与えた幼虫に比べ、摂食物の転換効率がよく、成長も若干速く、成長量も大きいことから、ヤマハギは、他の2種に比べ餌としてやや優れると思われる。しかし、その差は小さく、メドハギ、ネムも餌として、十分キチョウの生育を支ええると考えられる。

野外調査は、茨城県新治郡桜村、筑波大学構内の草地で1981年8月～9月に行った。産卵植物の調査ではメドハギ、ヤマハギ、ネムの3種の植物より卵が発見され、メドハギで最も多く発見された。調査地域内では、キチョウは若葉にのみ産卵することが観察されたので、これら3種の植物の産卵に適した部分を好適な産卵場所として比較した。3種の植物間では、株当りの産卵率には差がなかったが、好適産卵場所に対する産卵率では差があり、メドハギで一番高率であった。

♀の産卵行動の観察では、産卵中の♀を追跡し、止った植物、止った回数、産卵したかどうか、産卵数について調査した。産卵行動中の♀は、多くのマメ科植物に止り、とくに細長く、草地から上へ突き出た植物や枝によく止る傾向がみられた。実際に産卵が観察された植物は、メドハギ、ヤマハギ、ネムの3種であった。メドハギに多く止り、多く産卵する傾向がみられた。

調査を行った付近では、草地、松林がパッチ状に分布している。メドハギは草地に多く、ヤマハギとネムは草地よりむしろ林縁や林内の空地に多く分布する。キチョウは草地ではメドハギを多く利用する傾向がみられるが、3種に産卵する習性は、産卵の機会を増加させると共に、異なる環境を生息場所として利用することを可能にすると考えられる。